THE AIR FORCE RESEARCH LABORATORY

LEAD | DISCOVER | DEVELOP | DELIVER

Air Force Maui Optical & Supercomputing Site

(Technology Overview)

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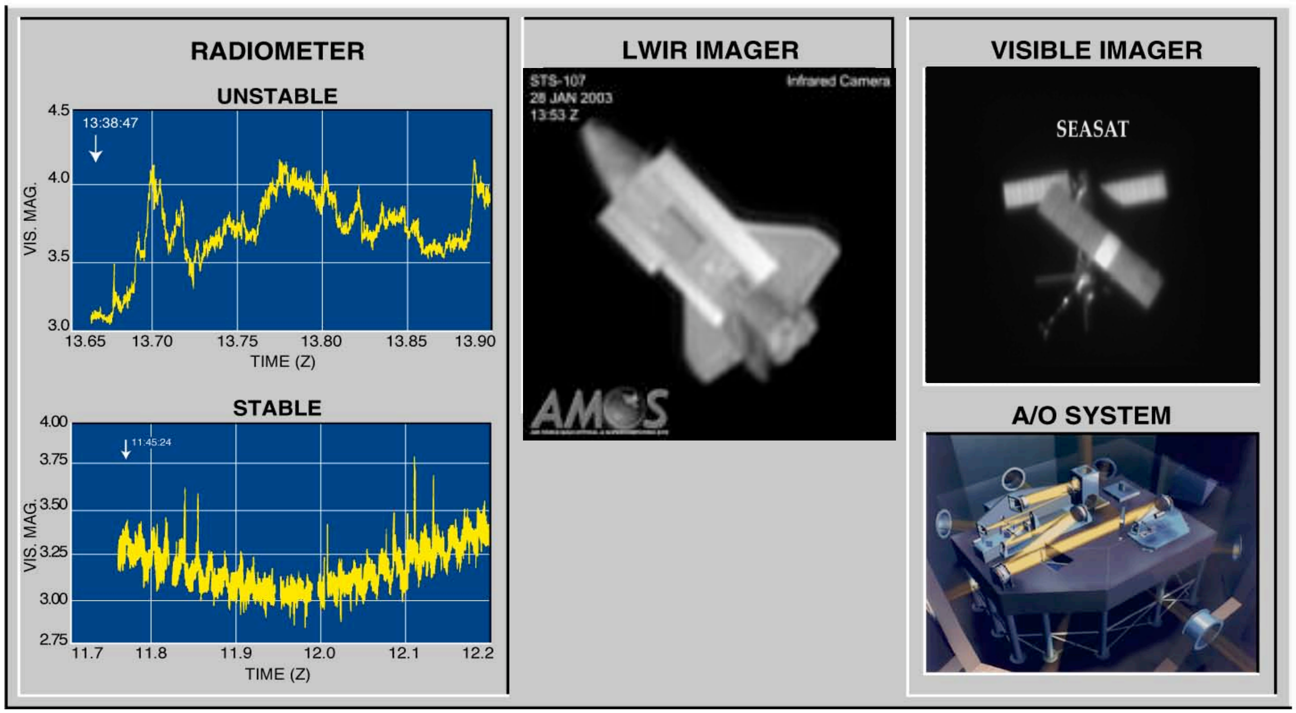
3.6-meter Telescope Sensor Suite Covers Visible through LWIR Spectrum

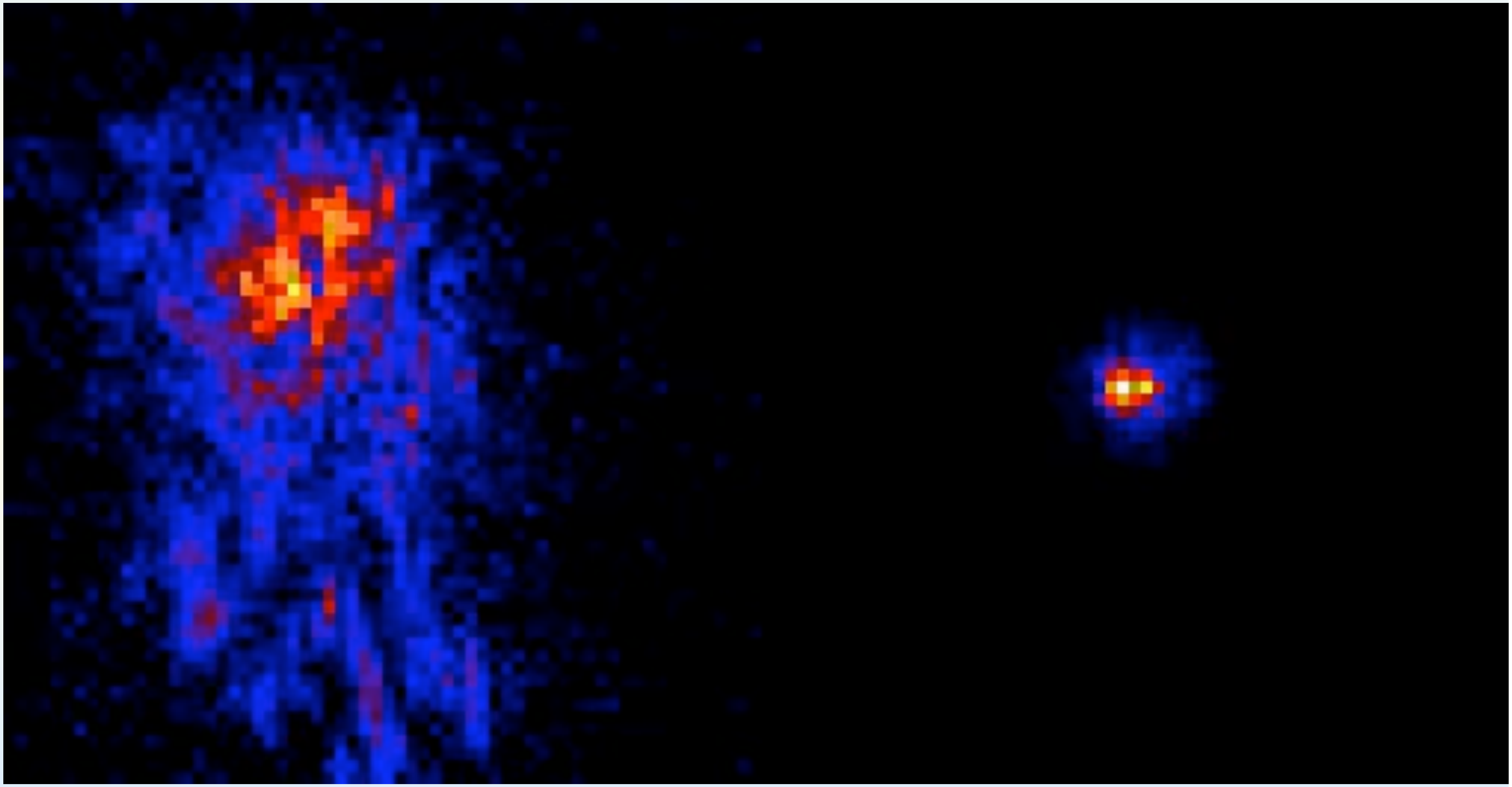
Data shows satellite orientation stability



Field data results - using adapti optics (A/O) compensatio

Sensor	*Aperture (cm)*	*Spectral Range (um)*	*Full FOV*	*Array Size*	*Detector Type*
Wide FOV Acquisition	**20**	**0.4 - 0.9**	**2.7 deg**	**512^2**	**ICCD**
Narrow FOV Acquisition	**58**	**0.4 - 0.9**	**0.45/0.125 deg**	**512^2**	**ICCD Visible: Si**
MW Acquisition	**45**	**3 – 5**	**0.3 deg**		**MWIR: InSb**
Photometer / Radiometer	**363**	**0.4 - 14**	**15 - 150 urad (Electronic)**	**128^2**	**LWIR: Si:As LWIR: Si:As**
LWIR Imager	**363**	**8 - 14**	**140 urad**	**200^2**	**Si:As**
Coude Visible	**363**	**0.7 - 0.9**	**50,120, 300**		

Adaptive Optics: Real-time Correction of Atmospheric Distortions



Atmospheric distortions

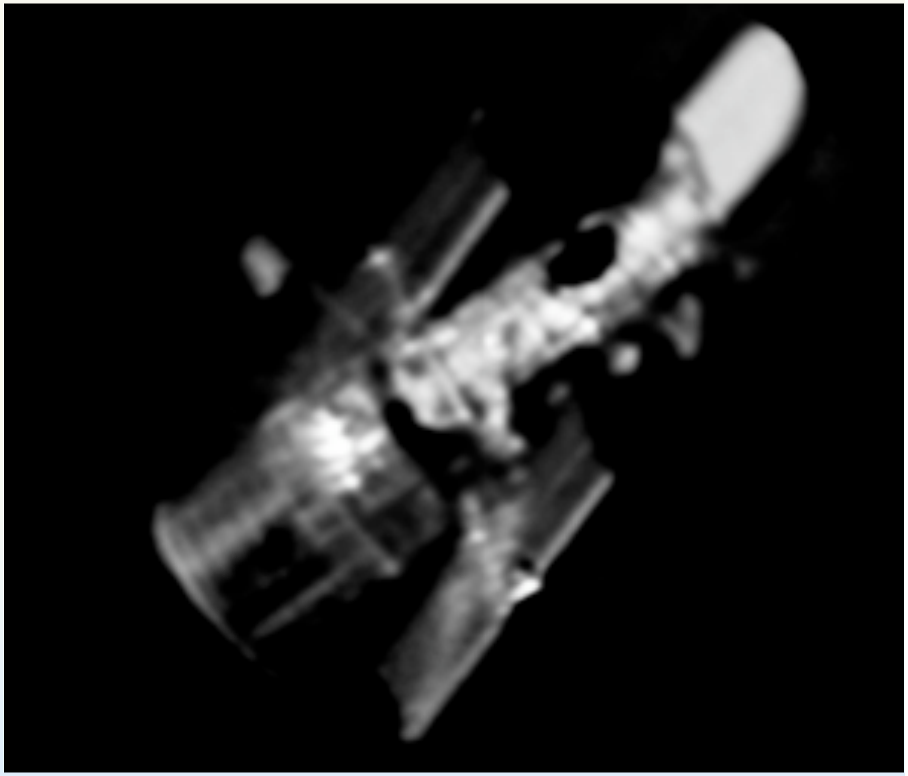
Adaptive optics compensation

A/O Adaptive Optics Imaging

Provides high-resolution visible imagery

- Adaptive Optics Compensation
  - Wavefront sensor
  - Deformable mirror
- Real-time correction
  - Atmosphere measured 200 cycles/second
  - Image recorded 5 frames/second

Hubble Space Telescope

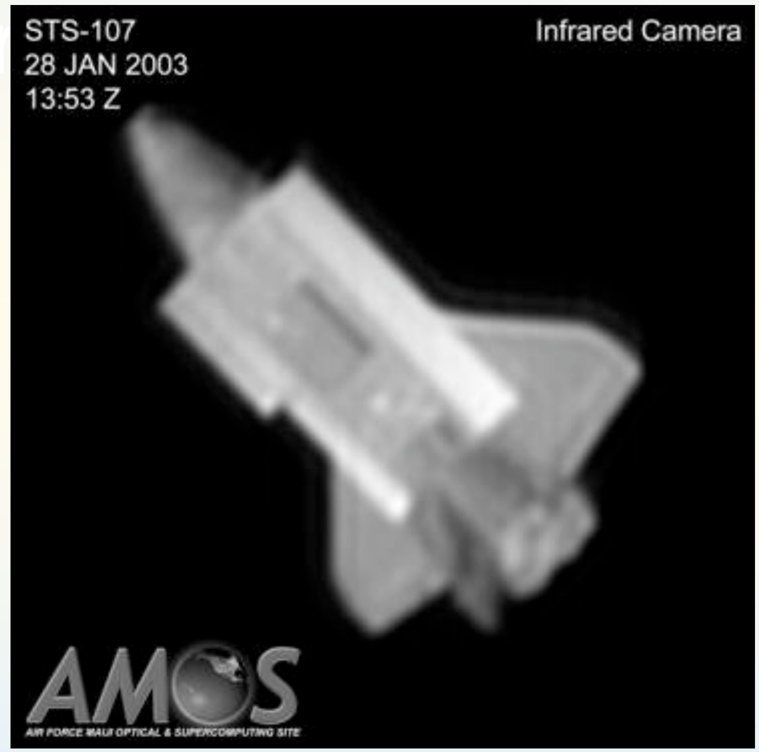


Adaptive Optics plus Multi-Frame Blind Deconvolution Processing

3.6-meter Telescope LWIR Imager (Long Wave Infrared)

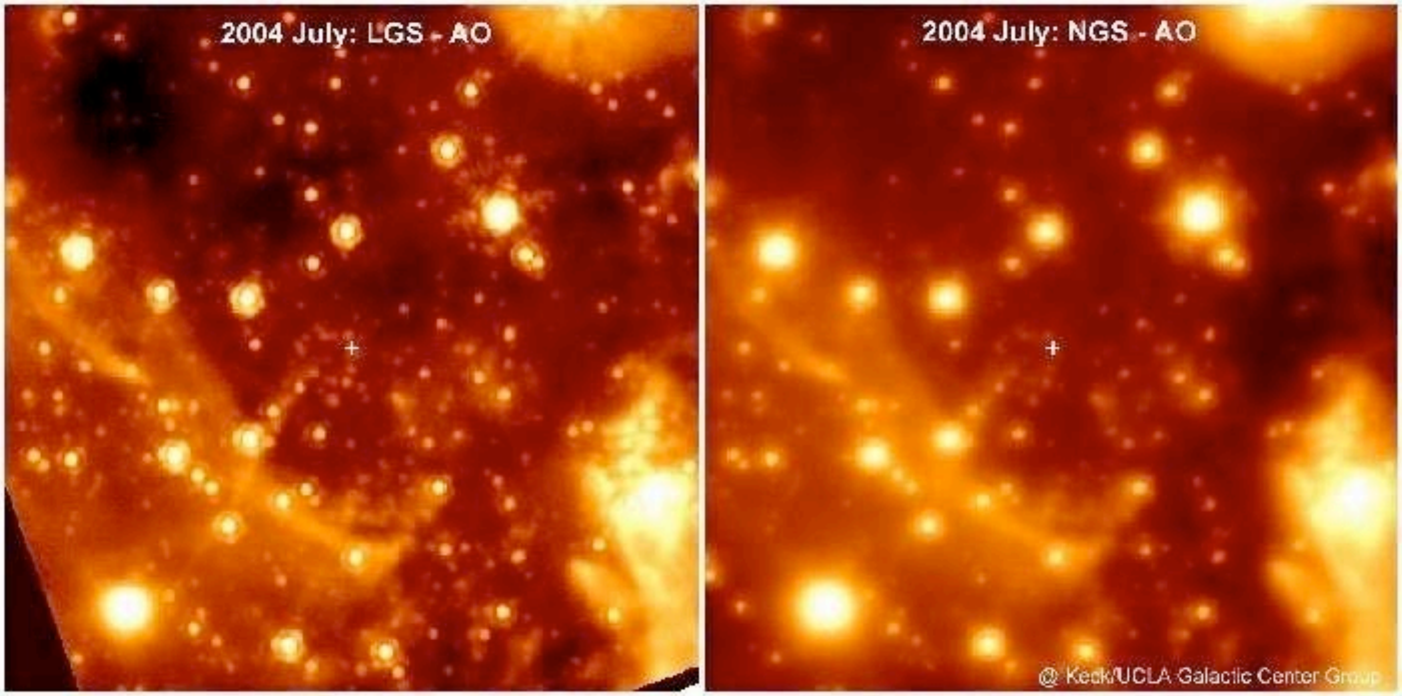
Provides high-resolution thermal imager

- Produces Temperature Estimates of Objects in Orbit
- Dual Si:As Focal Plane Arrays 8.1-9.1 µm & 10.1-12.9 µm
- Background-Limited Sensitivity
- Virtually Diffraction-Limited
- Operates Simultaneously w/ Visible Imager



Developed by Raytheon, El Segundo

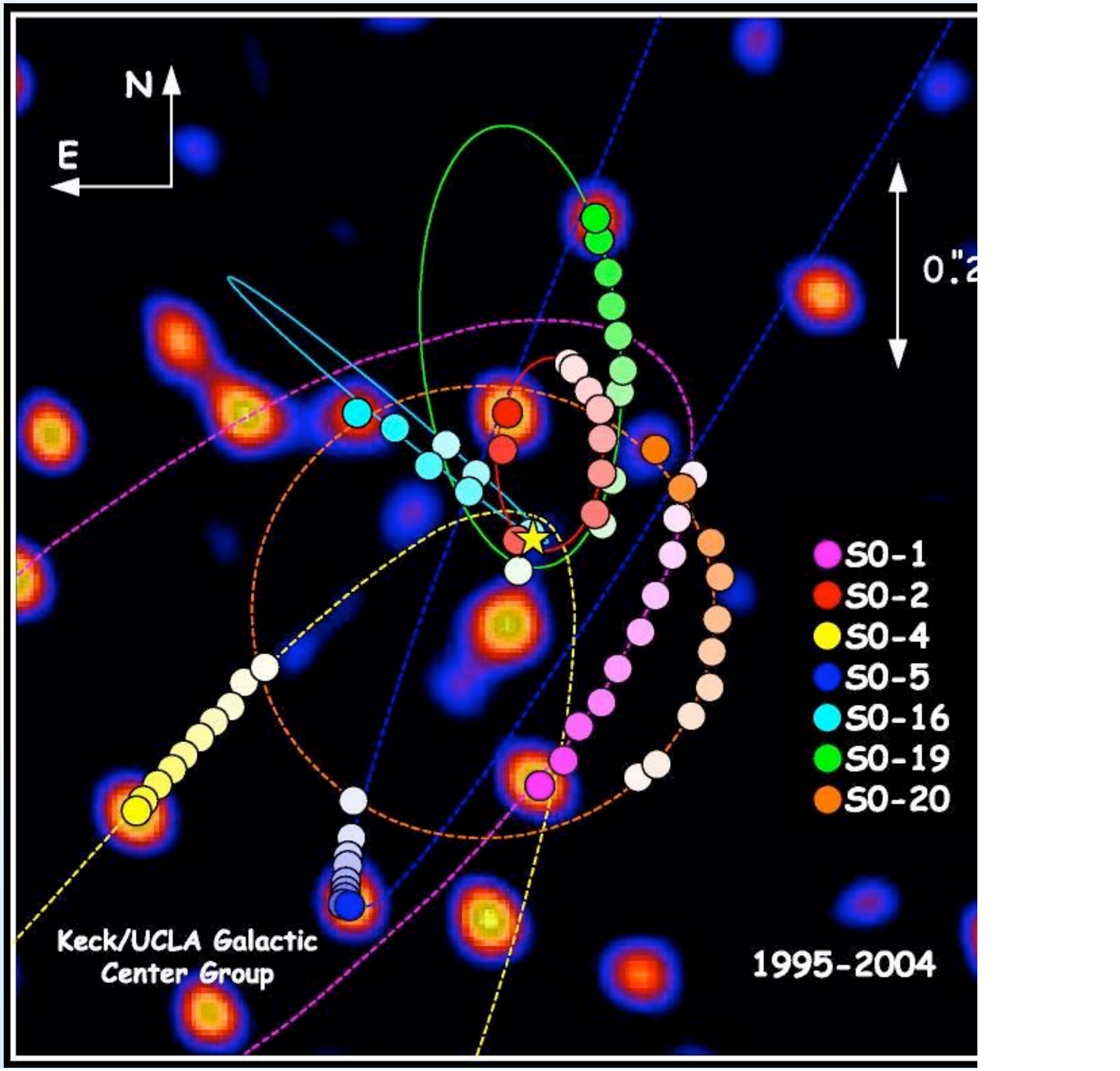
Laser Guide Star Adaptive Optics



- UCLA PRESS RELEASE (December 12th, 2005) UCLA astronomers and colleagues published the first high-resolution images of the center of our Milk Way galaxy, including the area surrounding the supermassive black hole, usin a new technology at the W.M. Keck Observatory in Hawaii.
  - “We have worked for years on techniques for ‘beating the distortions in th atmosphere’ and producing high-resolution images,” Andrea Ghez, UCLA professor of physics and astronomy said. “We are pleased to report the fi Laser Guide Star Adaptive Optics observations of the center of our galaxy

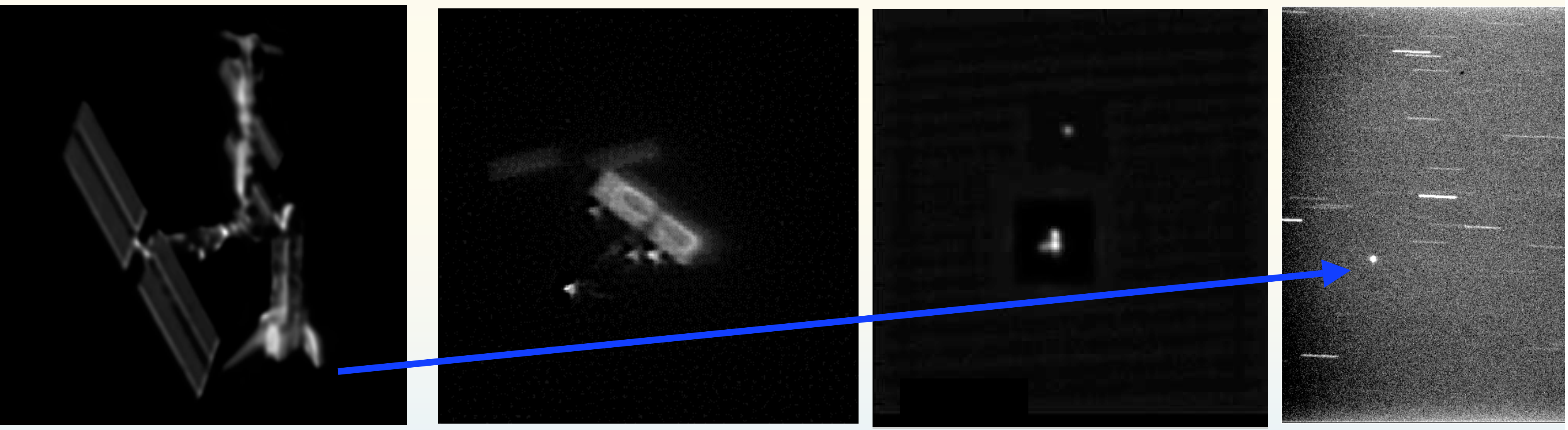
Discovery of Black Hole at Center of Milky Way Galaxy

MAUNA KEA, Hawaii (September 21st, 2000) In an historic first, astronomers from the University of California-Los Angeles have observed acceleration in the velocities of individual stars orbiting the gigantic black hole at the center of our galaxy. The astronomers are led by Andrea Ghez, UCLA professor of physics and astronomy.



Satellite Characterization

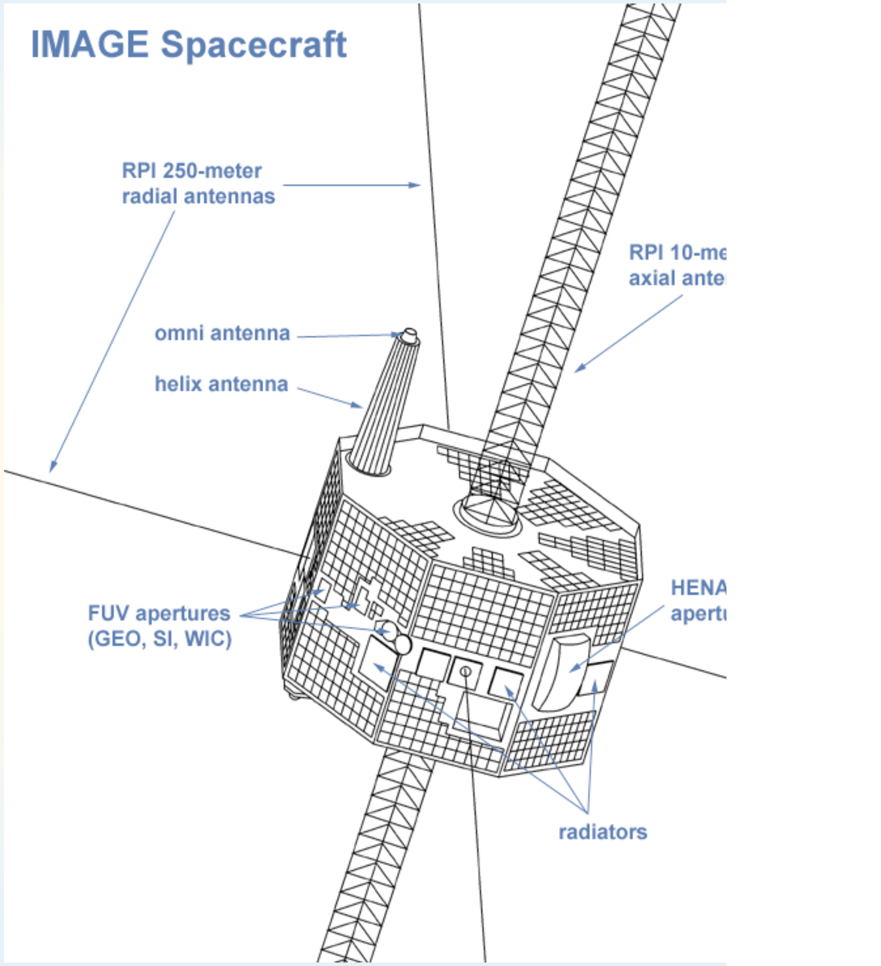
- As angular size of satellite decreases
  - Smaller satellite
  - Greater distance

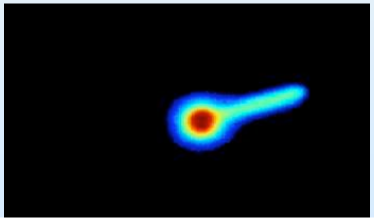


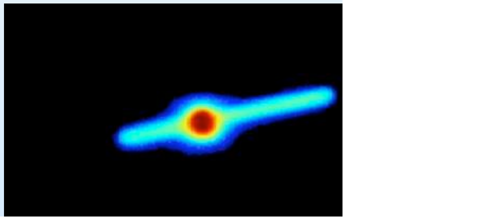
- As telescope aperture decreases
- Resolution decreases, until the satellite is completely unresol

NASA Satellite Anomaly Resolution

- Imager for Magnetopause-to-Aurora Global Exploration (IMAGE)
- Spacecraft anomaly:
  - No telemetry after 2005-DEC-18
  - No response after revival attempts
  - Does satellite maintain a spin-stabilized attitude?
  - Can spacecraft still receive/execute uplinked commands?
- Objective:
  - Obtain AMOS observations to help diagnose satellite status & anomaly



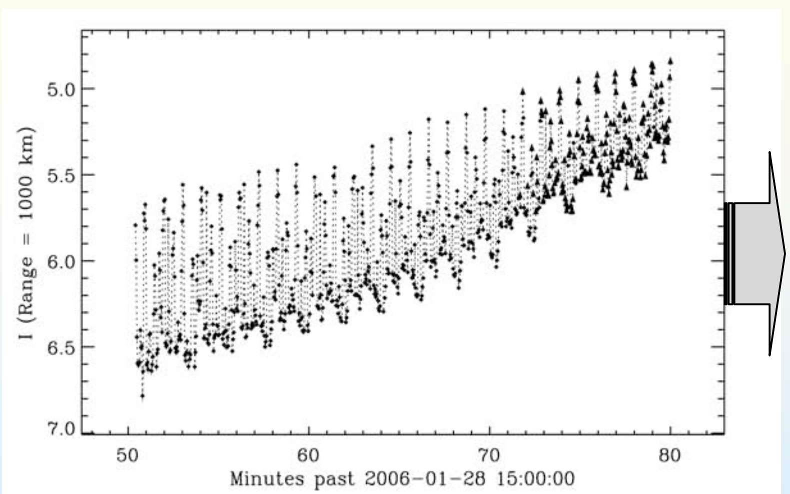


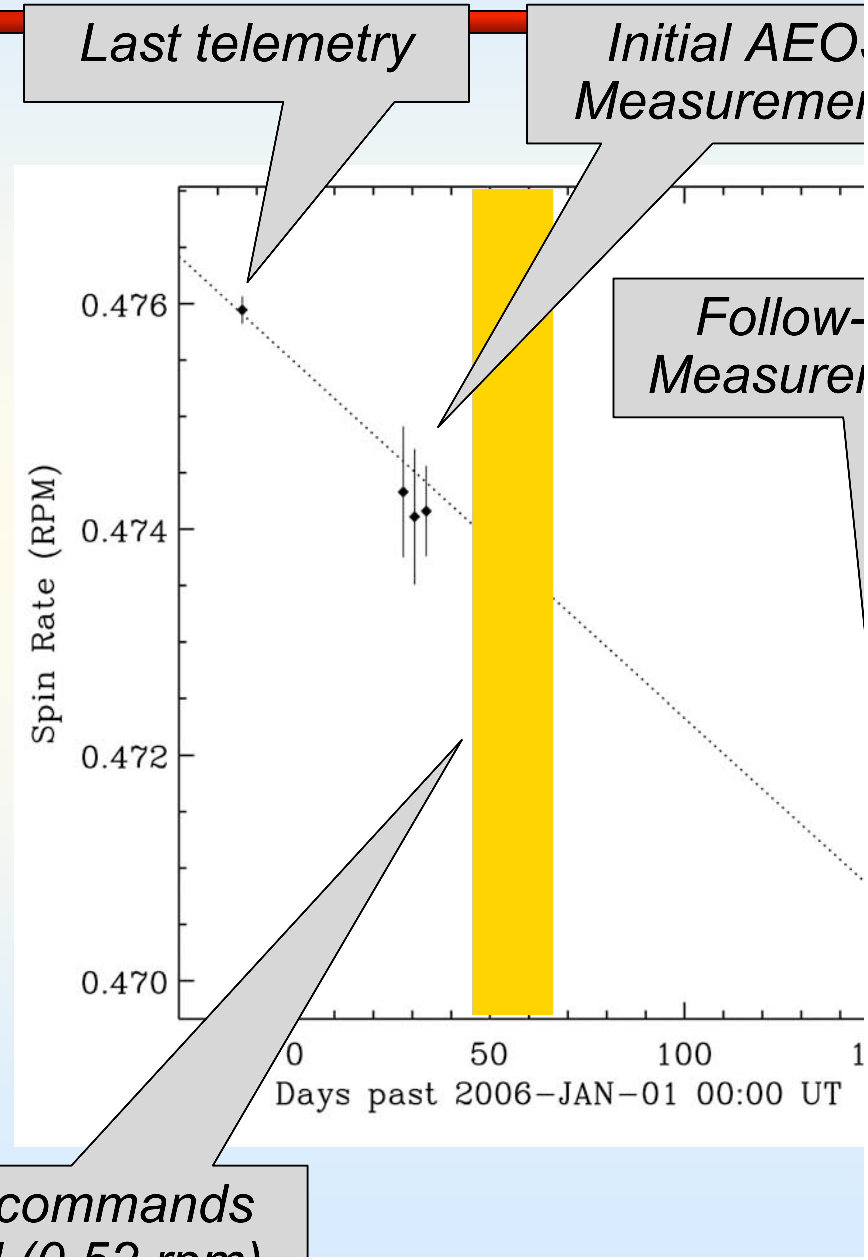


State of satellite antennae:
1 intact
1 missing (lost on orbit)
2 significantly truncated

Confirmed satellite unresponsive

- **Can satellite receive and execute commands?**
  - **AMOS measured spin rate**
  - **NASA commanded satellite to spin up**
  - **AMOS measured spin rate**
- **Conclusion: IMAGE unresponsive to up-linked commands and steadily spinning down**





AMOS

AIR FORCE MAUI OPTICAL & SUPERCOMPUTING SITE